Benchmark for Reactive Multiphase Flow in Porous Media
Full results

Etienne Ahusborde, Brahim Amaziane, Stephan deHoop,
Mustapha El Ossmani, Eric Flauraud, François P. Hamon,
Michel Kern, Adrien Socié, Danyang Su,
K. Ulrich Mayer, Michal Tóth and Denis Voskov

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1 Test 1.1: 1D kinetic chemistry

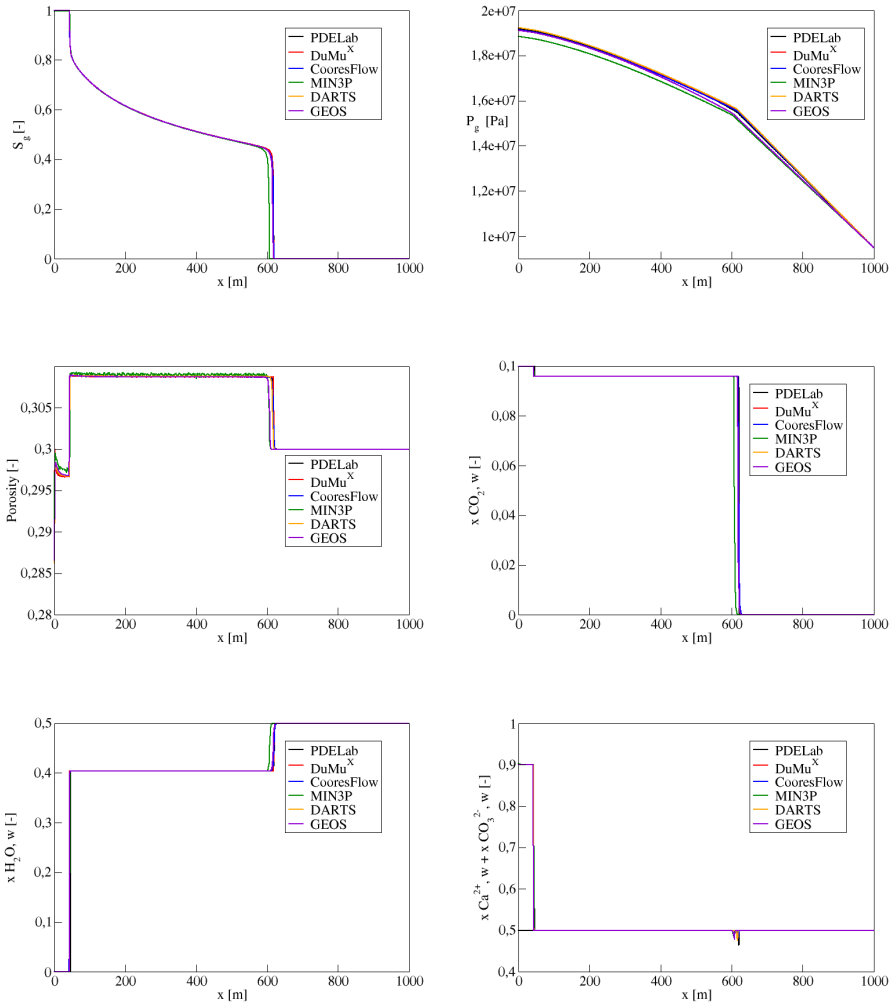


Figure 1: Comparison of gas saturation (top left), gas pressure (top right), porosity (middle left), liquid CO_2 fraction (middle right), liquid water fraction (bottom left), liquid total ion fraction (bottom right) at $t = 1000$ days for Test 1.1.

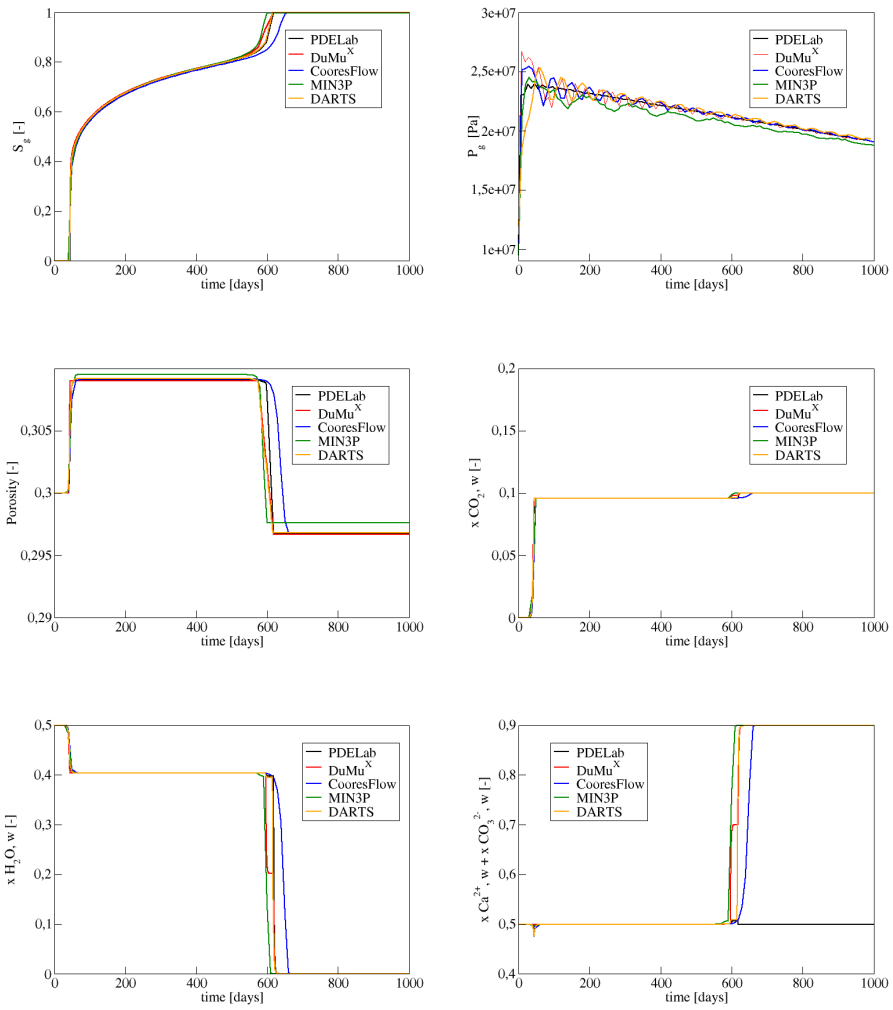


Figure 2: Comparison of gas saturation (top left), gas pressure (top right), porosity (middle left), liquid CO_2 fraction (middle right), liquid water fraction (bottom left), liquid total ion fraction (bottom right) at $x = 25$ m for Test 1.1.

2 Test 1.2: 1D equilibrium chemistry

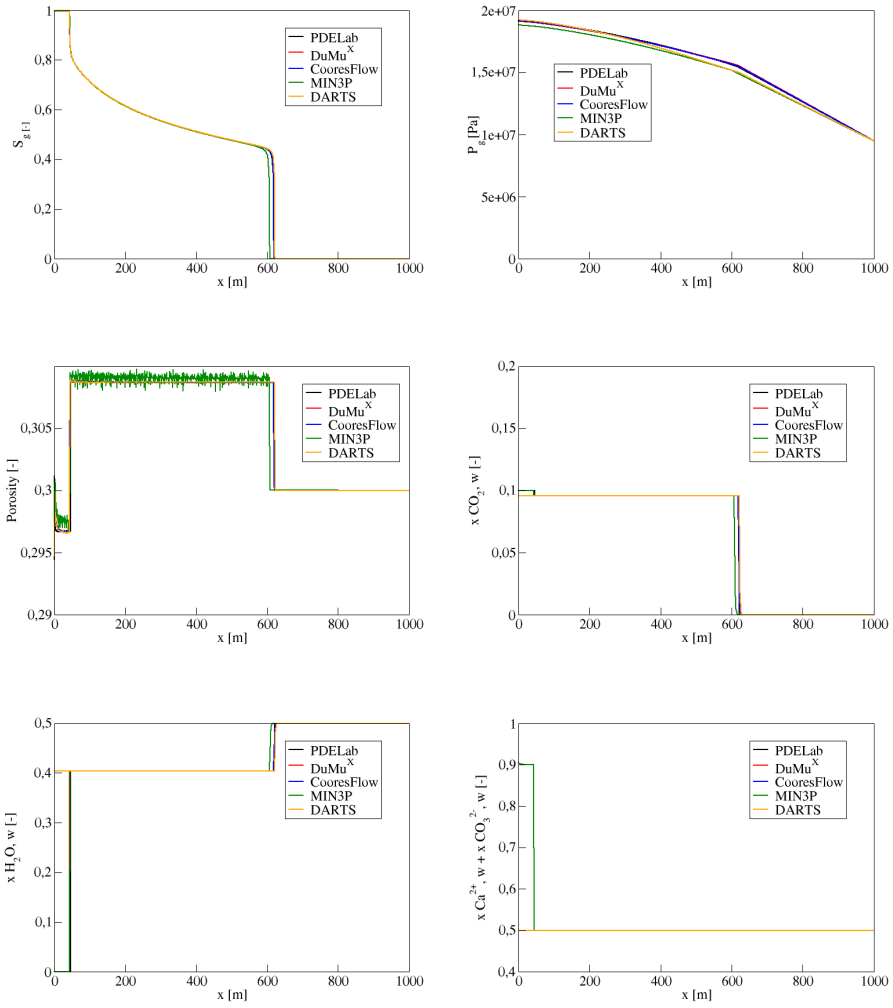


Figure 3: Comparison of gas saturation (top left), gas pressure (top right), porosity (middle left), liquid CO_2 fraction (middle right), liquid water fraction (bottom left), liquid total ion fraction (bottom right) at $t = 1000$ days for Test 1.2.

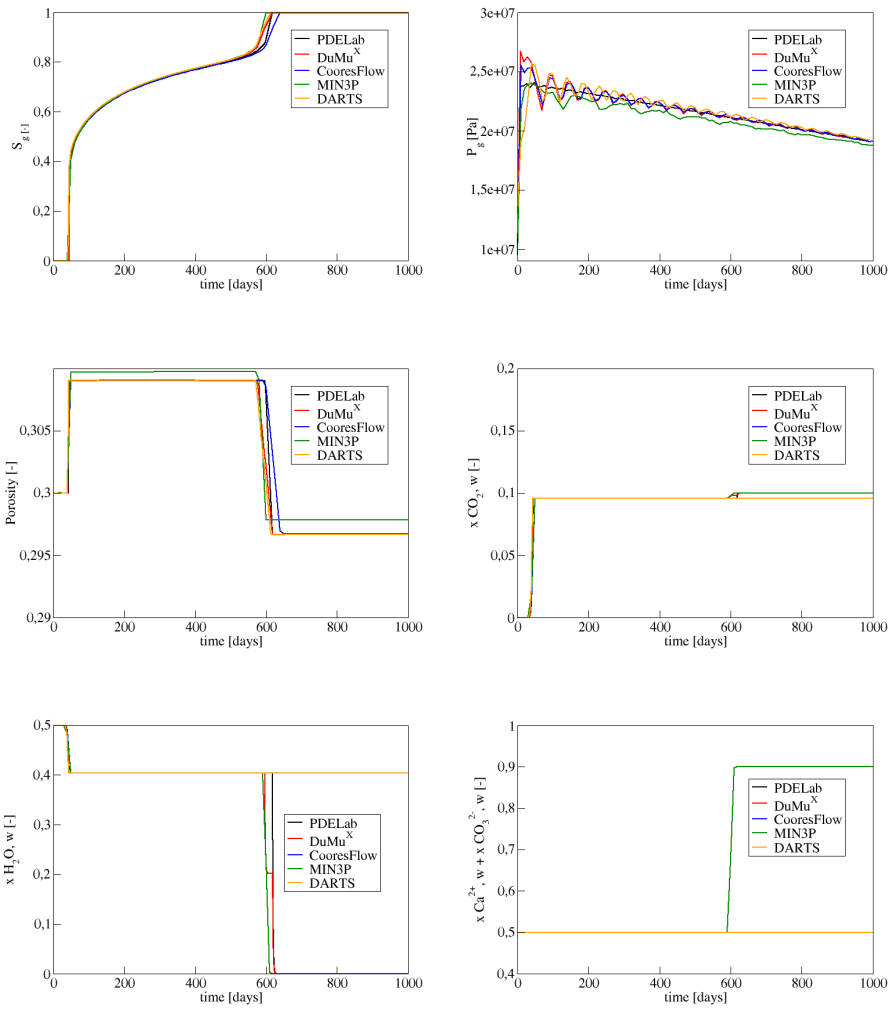
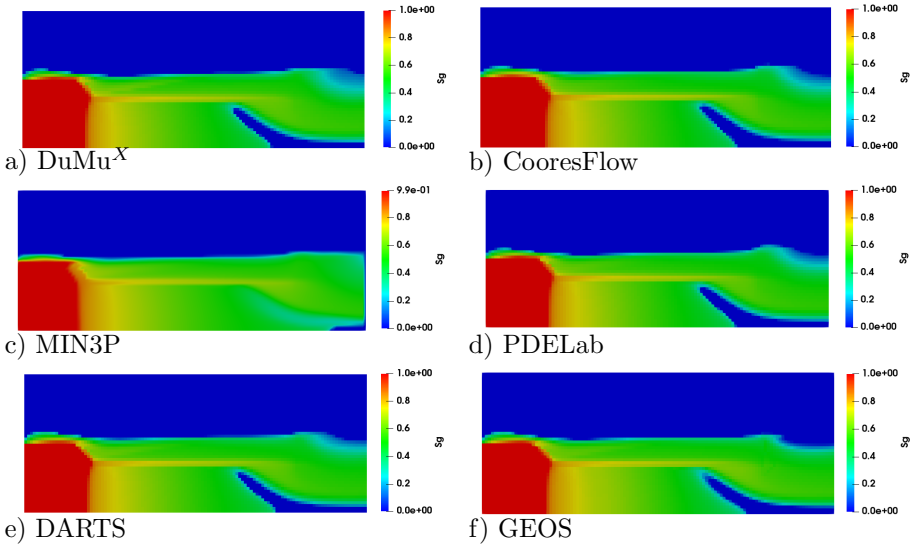


Figure 4: Comparison of gas saturation (top left), gas pressure (top right), porosity (middle left), liquid CO_2 fraction (middle right), liquid water fraction (bottom left), liquid total ion fraction (bottom right) at $x = 25$ m for Test 1.2.

3 Test 2.1: 2D without gravity

3.1 Contour maps for the Test 2.1 without gravity



a) DuMu^X b) CooresFlow

c) MIN3P d) PDELab

e) DARTS f) GEOS

Figure 5: Comparison of gas saturation S_g at $t = 1000$ days for Test 2.1 without gravity.

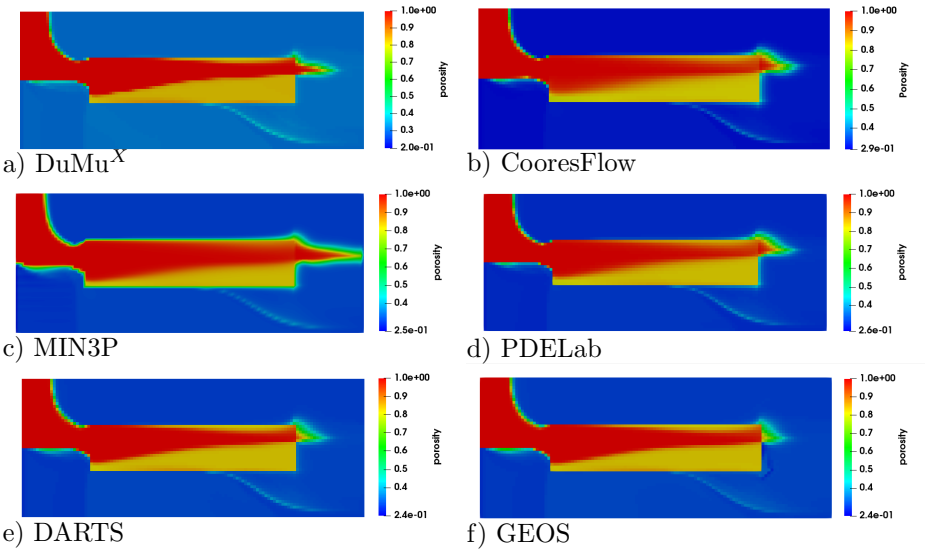


Figure 6: Comparison of porosity ϕ at $t = 1000$ days for Test 2.1 without gravity.

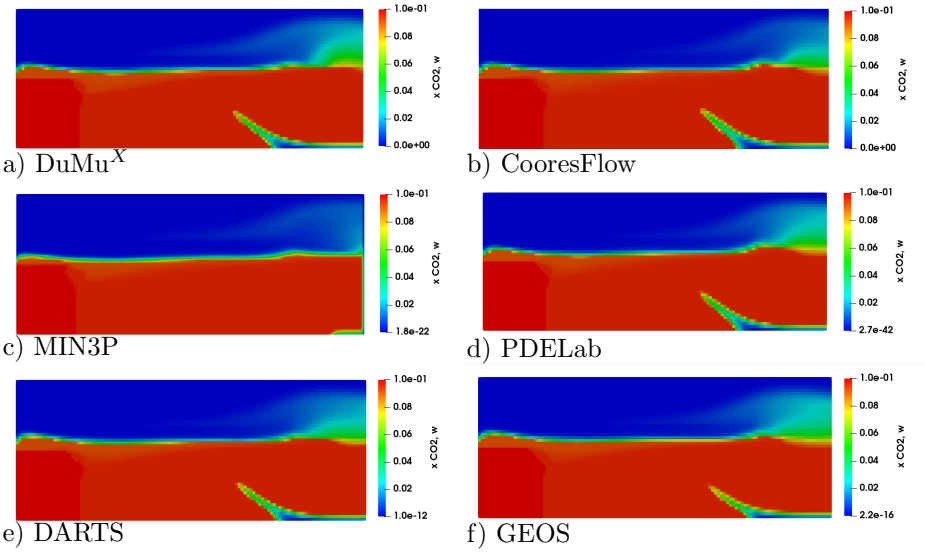


Figure 7: Comparison of liquid CO_2 fraction $x_{CO_2,w}$ at $t = 1000$ days for Test 2.1 without gravity.

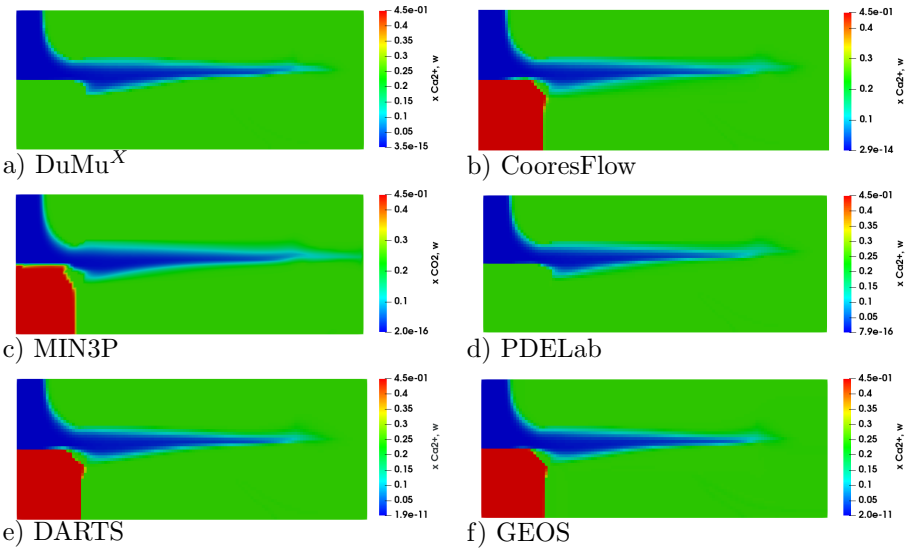


Figure 8: Comparison of liquid Ca^{2+} fraction $x_{Ca^{2+},w}$ at $t = 1000$ days for Test 2.1 without gravity.

3.2 Vertical line at $x = 40$ m for the Test 2.1 without gravity

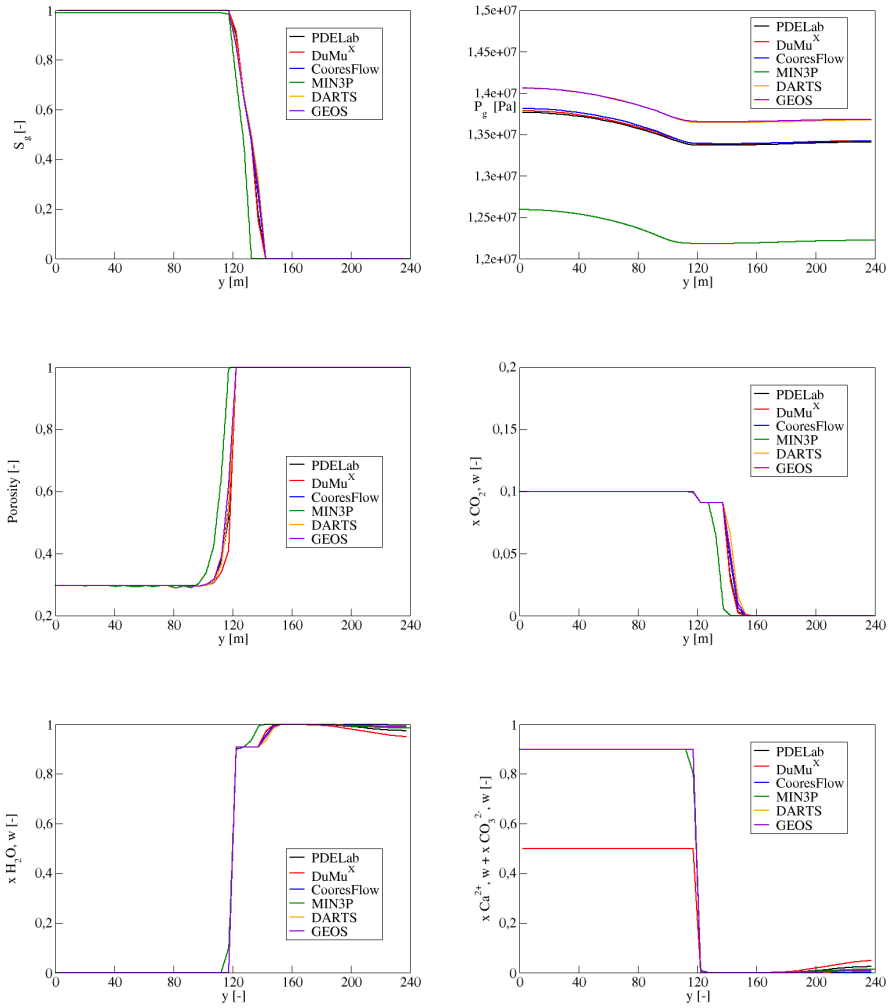


Figure 9: Comparison of gas saturation (top left), gas pressure (top right), porosity (middle left), liquid CO_2 fraction (middle right), liquid water fraction (bottom left), liquid total ion fraction (bottom right) at $t = 1000$ days on vertical line $x = 40$ m for Test 2.1 without gravity.

3.3 Horizontal line at $y = 50$ m for the Test 2.1 without gravity

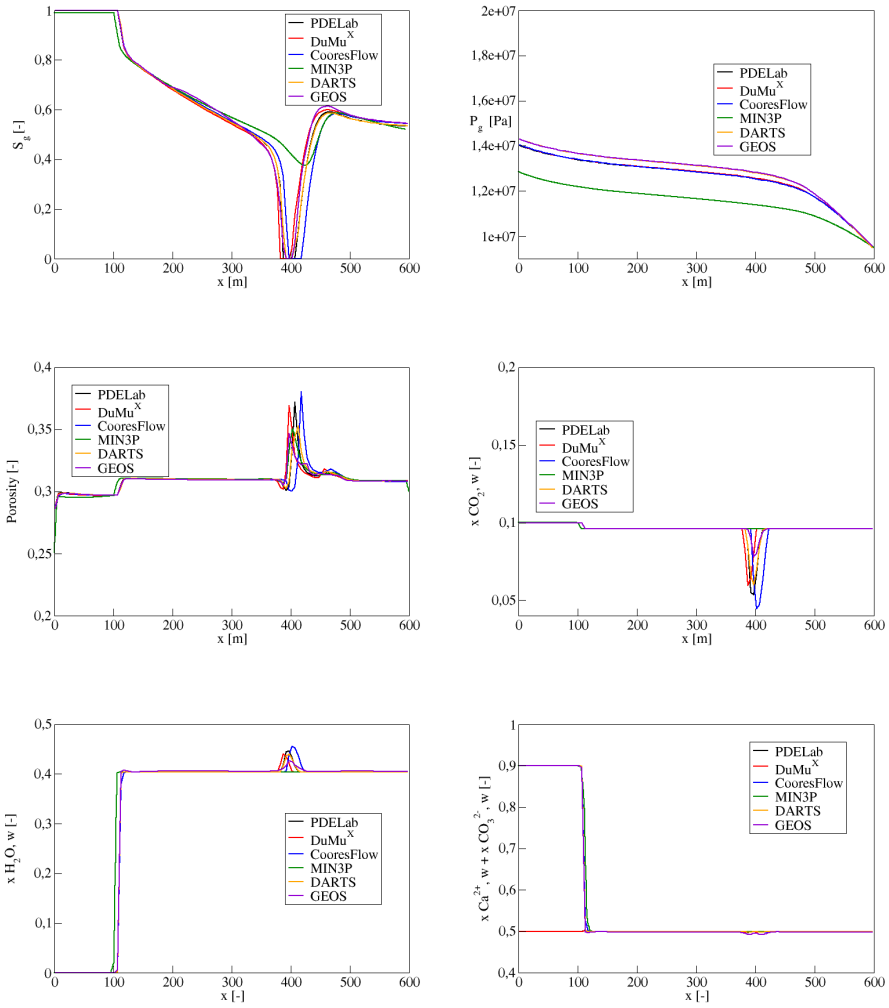
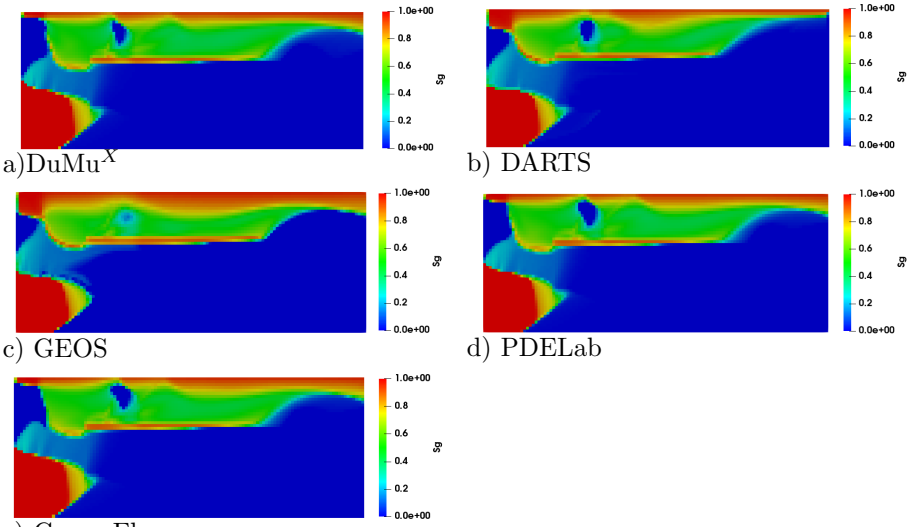


Figure 10: Comparison of gas saturation (top left), gas pressure (top right), porosity (middle left), liquid CO_2 fraction (middle right), liquid water fraction (bottom left), liquid total ion fraction (bottom right) at $t = 1000$ days on the horizontal line $y = 50$ m for Test 2.1 without gravity.

4 Test 2.1 : 2D with gravity

4.1 Contour maps for the Test 2.1 with gravity



a)DuMu^X b) DARTS

c) GEOS d) PDELab

e) CooresFlow

Figure 11: Comparison of gas saturation S_g at $t = 1000$ days for the 2D test with simple chemistry and with gravity.

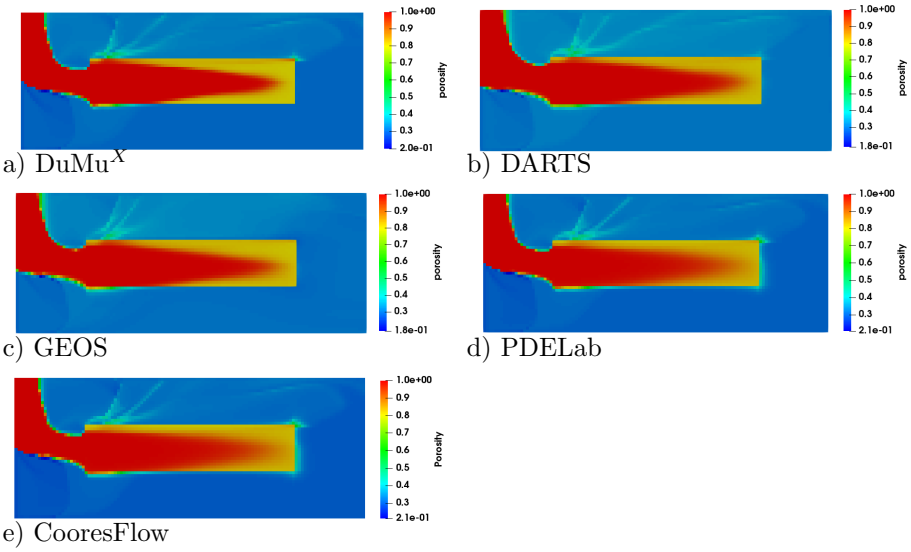


Figure 12: Comparison of porosity ϕ at $t = 1000$ days for the Test 2.1 with gravity.

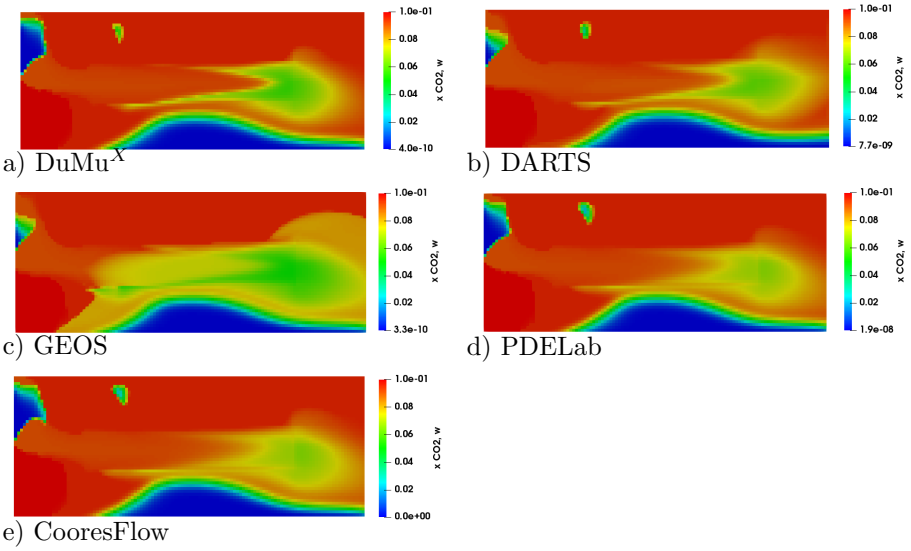


Figure 13: Comparison of liquid CO_2 fraction $x_{CO_2,w}$ at $t = 1000$ days for the Test 2.1 with gravity.

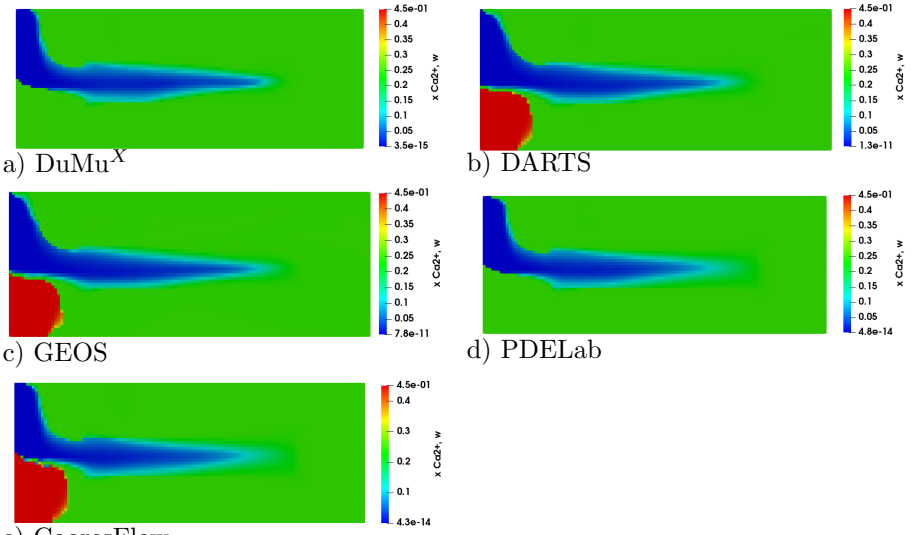


Figure 14: Comparison of liquid Ca^{2+} fraction $x_{Ca^{2+},w}$ at $t = 1000$ days for the Test 2.1 with gravity.

4.2 Vertical line at $x = 40$ m for the Test 2.1 with gravity

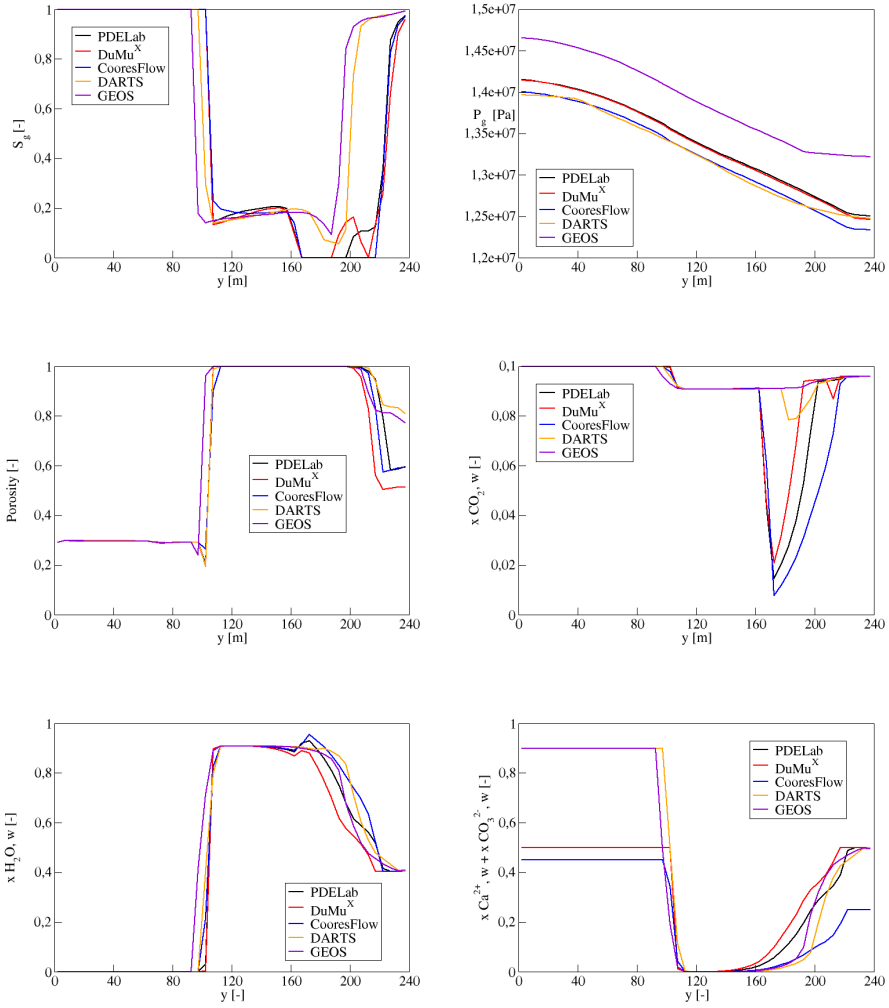


Figure 15: Comparison of gas saturation (top left), gas pressure (top right), porosity (middle left), liquid CO_2 fraction (middle right), liquid water fraction (bottom left), liquid total ion fraction (bottom right) at $t = 1000$ days on vertical line $x = 40$ m for Test 2.1 with gravity.

4.3 Horizontal line at $y = 50$ m for the Test 2.1 with gravity

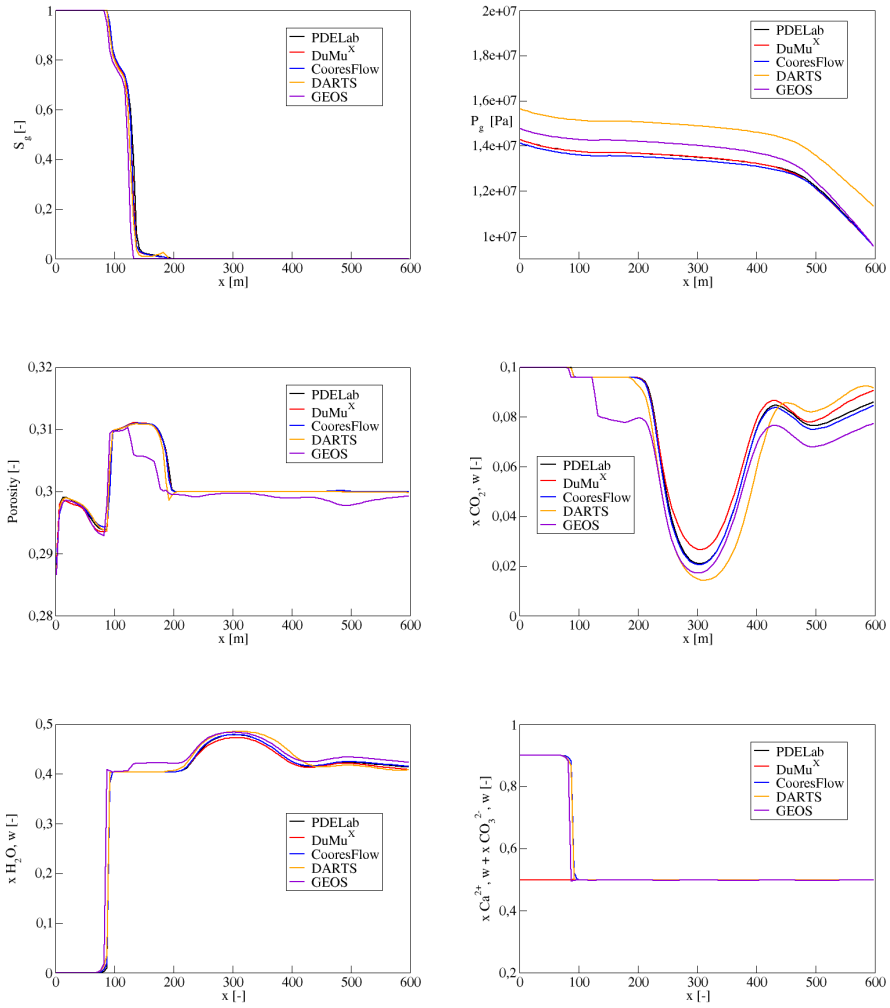
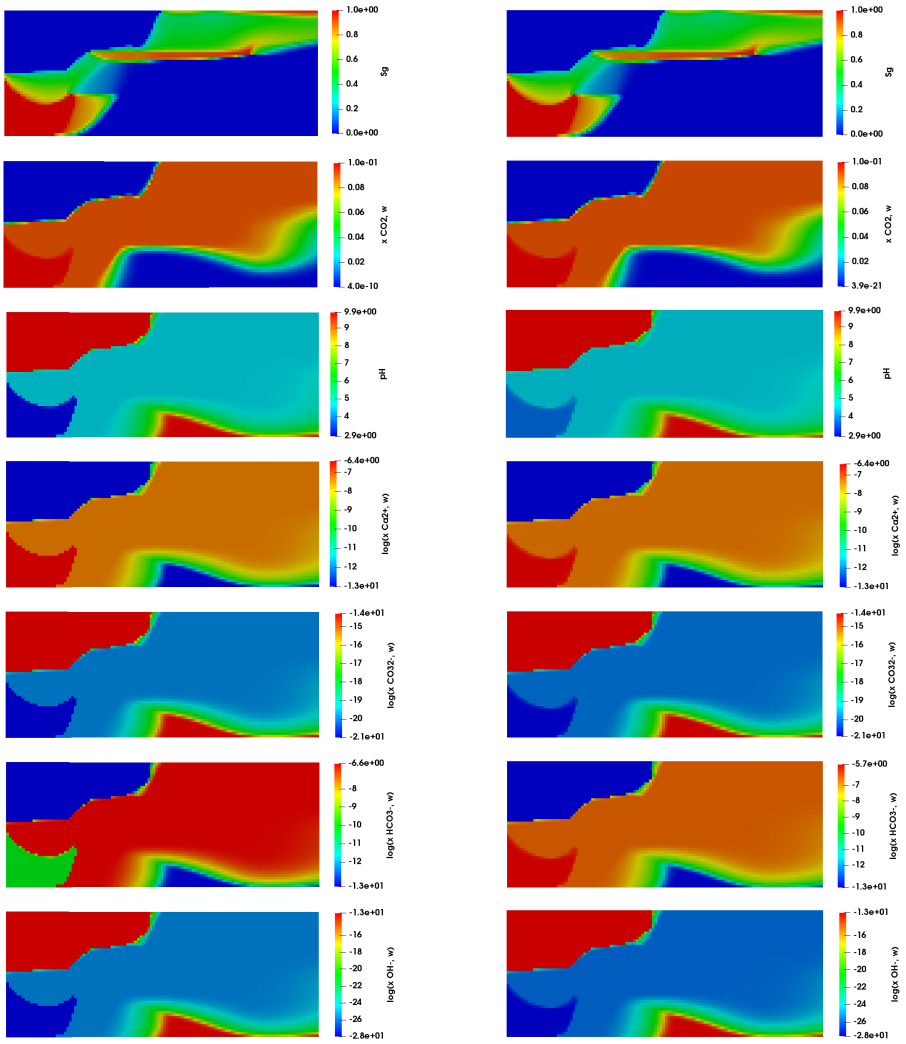


Figure 16: Comparison of gas saturation (top left), gas pressure (top right), porosity (middle left), liquid CO_2 fraction (middle right), liquid water fraction (bottom left), liquid total ion fraction (bottom right) at $t = 1000$ days on vertical line $y = 50$ m for Test 2.1 with gravity.

5 Test 2.2: 2D extended chemical system

5.1 Contour maps for Test 2.2



a) DuMu^X b) CooresFlow

Figure 17: Comparison of several quantities at $t = 1000$ days for the Test 2.2 (left column: DuMu^X, right column: CooresFlow). From top to bottom: gas saturation, liquid CO_2 fraction, pH, logarithm of liquid Ca^{2+} fraction, logarithm of CO_3^{2-}, logarithm of liquid HCO_3^- fraction, logarithm of OH^-

5.2 Vertical line at $x = 40$ m for the Test 2.2

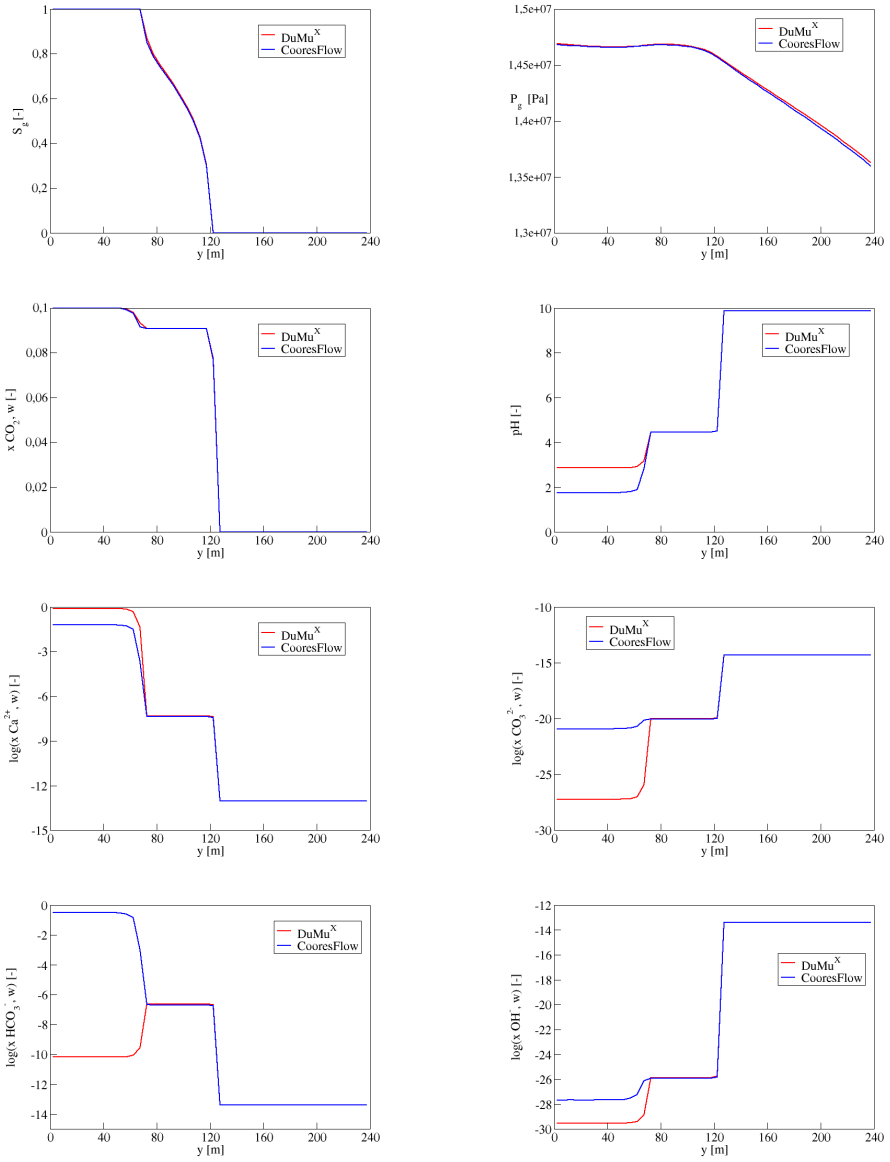


Figure 18: Comparison of gas saturation (top left), gas pressure (top right), liquid CO_2 fraction (second row left), pH (second row right), logarithm of liquid Ca^{2+} fraction (third row left), logarithm of liquid CO_3^{2-} fraction (third row right) , logarithm of HCO_3^- (bottom left), logarithm of OH^- (bottom right) at $t = 1000$ days on vertical line $x = 40$ m for Test 2.2.

5.3 Horizontal line at $y = 50$ m for the Test 2.2

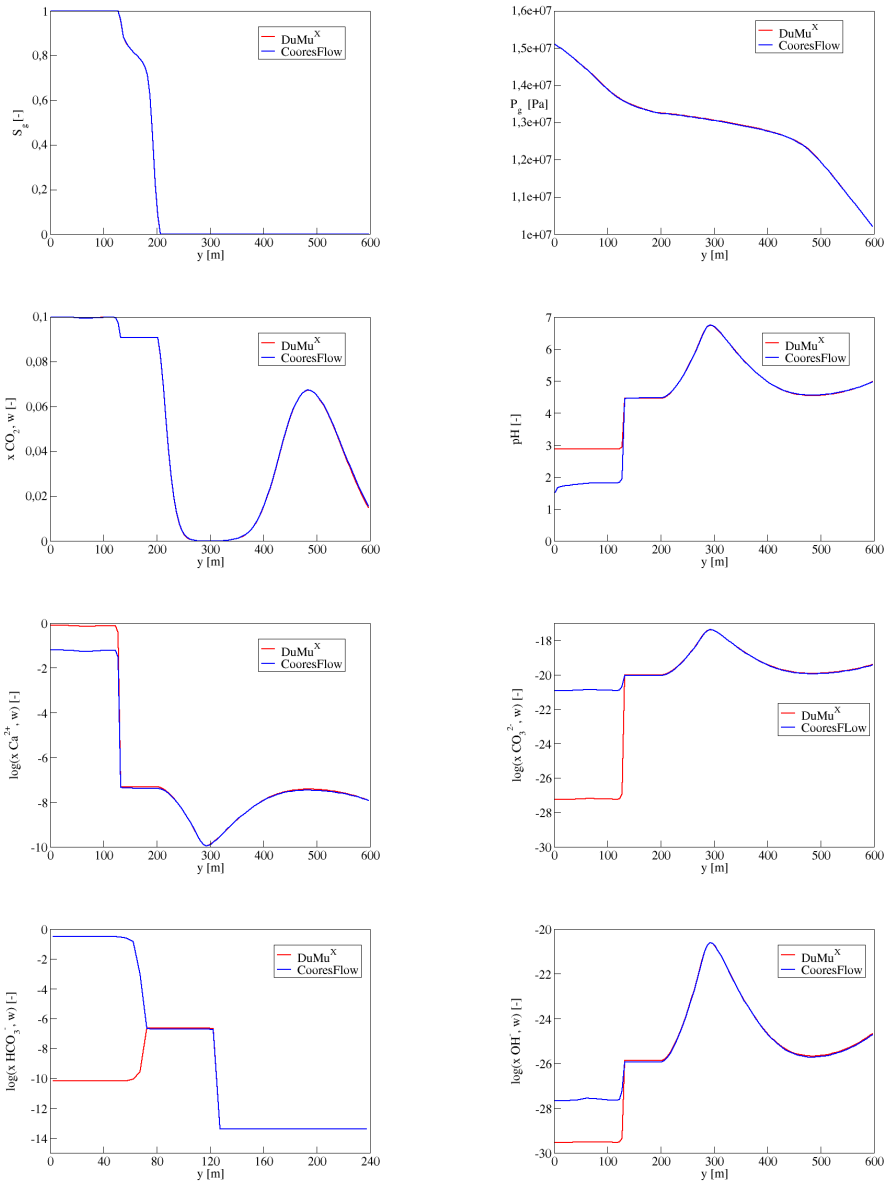


Figure 19: Comparison of gas saturation (top left), gas pressure (top right), liquid CO_2 fraction (second row left), pH (second row right), logarithm of liquid Ca^{2+} fraction (third row left), logarithm of liquid CO_3^{2-} fraction (third row right) , logarithm of HCO_3^- (bottom left), logarithm of OH^- (bottom right) at $t = 1000$ days on vertical line $y = 50$ m for the Test 2.2.